EXHIBIT "B"

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March 13, 2006

Mr. Paul R. Robinson
Meyer Darragh Buckler Bebeneck & Eck
U.S. Steel Tower – Suite 4850
600 Grant Street
Pittsburgh, PA 15219

Re: Lindquist, Tina v. Heim, L.P.
Your file no.: ALFA-107530

Dear Mr. Robinson:

In accordance with your request, I have completed my review of the documents provided by your office and summarize my opinions and conclusions relative to the foot control provided by Heim for use with the Mechanical Press Brake involved in Tina Lindquist's accident on September 25, 2002.

Documents Reviewed

1. Complaint in Civil Action
2. OSHA Investigation file
3. Instructions and Parts Book for Heim Mechanical Press Brakes
4. Sales documentation for the Heim Press Brake
5. Corry Manufacturing Accident report file
6. Deposition testimony
    a. Tina Lindquist, taken on June 28, 2005
    b. Gary Dietz, taken on July 21, 2005
    c. Gary Merkle, taken on July 21, 2005
    d. Kevin Messinger, taken on July 21, 2005
    e. Jan Oviatt, taken on July 22, 2005
    f. Dave Phillips, taken on July 22, 2005
    g. Joel Nichols, taken on July 22, 2005
    h. Anthony Mase, Jr., taken on July 27, 2005
    i. Robert Rooney, taken on September 8, 2005
    j. Jamie Ossa, taken on September 8, 2005
    k. Zygmund Zajdel, taken on January 23, 2006

7. Post-accident photographs and videotape of the Heim Press Brake and tooling
8. Interrogatories and Responses
9. Document Production Requests
10. PA-OSHA Consultation Program file
11. PMA Insurance claims notes
12. Codes and Standards
    a. Safety Requirements for Power Press Brakes, ANSI B11.3- 1973, 1982 and 2002
    b. Safety Requirements for Mechanical Power Presses, ANSI B11.1-1971 and 1982
13. Linemaster Switch Corp.
    a. current product literature
    b. patent no. 2,957,960
14. Safety Literature
    a. Philosophical Aspects of Dangerous Safety Systems; Barnett and Hamilton; December, 1982
    b. Safeguard Evaluation Protocol; Barnett and Schmid; May, 1995
    c. Foot Controls – Riding the Pedal; Barnett; July, 1997
    d. Foot Control Activation – Reciprocating vs. Pivoting; Barnett and Barroso; September, 1998
    e. Safeguarding Workers and Protecting Workers from Amputations; U.S. Department of Labor, OSHA 3170, 2001

Accident Description

On the day of the accident, Tina Lindquist was employed at Corry Manufacturing in Corry, Pennsylvania as a press operator. She was assigned to operate the Heim power press brake, model 70-6, serial no. 2176, using a hands-in-die parts feeding and removal procedure. The press brake was equipped with a dual hand control as well as an electric foot control. The operating method was selected through the use of a supervisory key lock selector switch mounted on the dual hand control pedestal. The foot control activation method was selected and in use at the time of the injury.

Ms. Lindquist indicated she was not aware the dual hand control was available for use on the subject press brake nor was she trained to avoid reaching into the point of operation of the press. She stated she was specifically instructed to reach into the point of operation region to pre-form the workpiece around a mandrel before actuating the foot control. Indeed, reaching into the point of operation region was the only way to introduce the work into the tooling of the press.

Ms. Lindquist had a chair available to her while operating the press brake and was found seated on the chair following the accident. From her operating position at the chair, Ms. Lindquist was able to reach into the press. The foot control was positioned on the floor in front of her to the right such that she was able to access it from her operating position using her right foot.

While hand forming the workpiece on the mandrel, Ms. Lindquist activated the foot control causing the press brake to cycle and crushing her fingers.

Foot Control Identification

It is understood that the foot switch control in use at the time of Mrs. Lindquist's accident was lost or disposed of following the sale of the Heim press brake by Corry Manufacturing after the accident.

According to the file documentation, the foot control originally supplied with the Heim press brake cannot be determined. However, it appears that the foot control in use at the time of the accident had a Linemaster Hercules Full Shield protecting the pedal from the top and both sides. The Full Shield is clearly shown in several photographs taken after the accident occurred. However, it is unclear whether the foot control shown in the post-accident photographs is a Linemaster product. To my knowledge, Linemaster Hercules pedals and shields, regardless of style, were painted orange. The pedal depicted beneath the shield in the photographs appears to be black.

Dave Phillips, a witness employed in Corry Manufacturing's maintenance department, indicated there are different colors of foot switches in use at Corry. There were black foot switches for the alloy machines and orange ones for the presses:

Phillips, pg. 92 to 93:

> Q. Are there any other different colors of foot switches in place at Corry?
> A. For certain machines, yes.
> Q. What other colors are there?
> A. There's little black ones for like alloy machines.
> Q. How about for the presses?
> A. They're all orange.

Hence, it is inconclusive whether the foot control assembly depicted in the photographs is a genuine Linemaster product or, perhaps, a hybrid of two different foot switch products.

On the other hand, Corry witnesses as well as the report prepared by Barnett and Ulmenstine identify a foot control equipped with a maintained latch mechanism. This feature requires full insertion of the users foot into the pedal housing to push the latch forward with the toe before the pedal can be depressed. Linemaster patented this feature in 1960 and, to my knowledge, manufactures the only foot switch with this safety feature. This foot control, currently called the "Hercules Anti-Trip Footswitch Full Shield Model"[1] is intended to help prevent accidental actuation.

Acceptance of the Model 532-SWH Foot Control in Safety Standards

The first safety standard that specifically addressed mechanical power press brakes was adopted in 1973, revised in 1982, reaffirmed twice, and revised again in 2002. The standard is identified as ANSI B11.3, *American National Standard for Machine Tools – Power Press Brakes – Safety Requirements for Construction, Care, and Use.*

In the report authored by Barnett and Ulmenstine, the claim is made that ANSI B11.3-1973 "is the first ANSI standard developed for press brakes. As such, it only addressed mechanical foot pedals." This claim is not accurate.

Not only does the standard recognize both mechanical and electric foot operating means, it provides terminology to distinguish each type. Note the published definitions of "Foot Control" and "Foot Pedal" in the 1973 standard[2]:

> *3.23 Foot Control.* A foot control is the foot-operated control mechanism (other than foot pedal) designed to control the movement of the ram on mechanical, hydraulic, or special-purpose power press brakes.
>
> *E3.23 Foot Control.* This control usually takes the form of an electrical switch that operates a solenoid or solenoid valve.
>
> *3.24 Foot Pedal.* A foot pedal is the foot-operated lever designed to operate the mechanical linkage that directly engages the clutch and disengages the brake on a mechanical power press brake while the pedal is held depressed.

The 1973 safety standard required that the foot control be protected against inadvertent actuation[3]:

> 4.3.4.3 *Foot Control.* A foot control, if used, shall be protected so as to inhibit accidental actuation by falling or moving objects, or by someone stepping on it.

A guard covering the top of the pedal pad was sufficient to comply with this requirement. Note that the code committee addressed the hazard of accidental actuation by using the language "stepping on" the pedal rather than "stepping into the pedal." Note that the only foot control illustration in the 1973 safety standard (Illustration 15)[4] shows an open front pedal design.

A foot control equipped with a top and side guarding arrangement, the equivalent to Linemaster's "Full Shield," is illustrated in the 1982[5] and 2002[6] revisions of the ANSI B11.3 safety standard.

A Linemaster "Full Shield" foot control is illustrated in the U.S. Department of Labor publication OSHA 3170, *Safeguarding Workers and Protecting Workers from Amputations.*[7] The foot control has no front lift gate and the illustration is captioned, "Properly Guarded Foot Control." Equally significant is the statement:

> "Foot controls must be guarded to prevent accidental activation by another worker or by falling material and not allow continuous cycling. They work best when the operator is in a sitting position. Always avoid the hazard of riding the pedal (keeping the foot on the pedal while not actively depressing it.)"

Note that OSHA does not require the foot control to prevent accidental activation by the foot control user, but rather "by another worker." It is correctly recognized that since the intended use of this control involves the user depressing the pedal, it is not possible to prevent the same person from inadvertently stepping into it.

The foot control involved in Ms. Lindquist's accident had two additional features to protect against inadvertent actuation of the pedal. The pedal was equipped with side guards as well as a toe latch feature that required the operator to fully insert their foot into the pedal guard and push a toe latch rearward before the pedal could be depressed. This safety feature exceeds any requirement for protection against inadvertent actuation expressed by any safety standard, past or present.

The 2002 safety standard for press brakes additionally recognizes the hazard associated with unattended actuation of the foot operating means. The supervisory key lock switch on the operator's control pedestal fulfills this requirement. When the press brake is unattended, the foot control can be disabled by turning the key in the control pedestal and removing it from the selector.

The Modern Foot Control vs. the Mechanical Foot Pedal

As Barnett and Ulmenstine point out in their report, the mechanical foot pedal of years past is characterized by locations close to the bed of the press, large activation resistance, and large pedal movements.

The modern foot control in use at the time of the accident was tethered on a long cord estimated to be 10 to 12 ft in length. This enables the foot control to be located at a "Safe Distance" from the press. In other words, if the press is utilized with no other point of operation guarding, the foot control can be located sufficiently far from the hazard that the press operator cannot reach the hazard from the operating position. In the case of a press

brake, the long cord also enables the foot control to be utilized while handling large work pieces that prevent the operator from being positioned near the bed of the press. The older style of mechanical foot pedal cannot accommodate this need.

The large activation resistance and pedal height associated with the mechanical foot pedal restricts the use of this device to standing operators. Balancing on one foot is required when activating a control of this nature, not to mention the operator fatigue associated with multiple activations over many hours of press brake work. As OSHA 3170 has correctly pointed out, the electric foot control works best when the operator is in a sitting position. The sitting position all but eliminates the problem of balancing oneself on one foot and reduces the physical fatigue associated with high pedal activation forces and large pedal movements. The electric foot control can also be utilized by a standing as well as a seated operator. It is simply a more versatile control means.

There are acceptable applications for both the electric foot control as well as the mechanical foot pedal. Only the press user is capable of making an appropriate decision regarding which style of control is the best and safest to use for a given production run.

Neither the mechanical foot pedal nor the electric foot control were adequate, by themselves, to satisfy the power press brake safety standard given the tooling and operating arrangement chosen by Corry Manufacturing at the time of Ms. Lindquist's injury. Additional point of operation guarding was needed, and required, to adequately protect Ms. Lindquist.

Foot Switch Utilized at the Time of the Accident

In their report, Barnett and Ulmenstine make reference to the footswitch in use at the time of the accident. They describe a Linemaster product

> "...constructed with an antitrip treadle mechanism, a latch that requires a certain foot insertion into the switch to depress the pedal."

This product could not have been the Linemaster Model 532-SWH originally supplied with the Heim press since the 532-SWH was not equipped with the antitrip treadle mechanism and latch trip lever. The Model 532-SWH was protected with a Full Shield covering the top and both sides of the treadle only. Indeed, according to Heim engineering drawing A-470-D, the anti-trip foot controls with latch trip lever (Linemaster Models 511-B2 and 511-B4) were not utilized by Heim until after November 9, 1982, four years after the date of manufacture of the product involved in the accident.

The Proposed Front-Gated Foot Control

Plaintiff's experts, Barnett and Ulmenstine, have proposed that a foot control with a front gate be utilized in an effort to avoid inadvertent tripping of the foot control.

Although research conducted on foot controls concludes that a front gate further reduces the probability of an inadvertent foot insertion, the same research also demonstrates that a critical undesirable "side effect" is created by the presence of the lift gate. In his July, 1997 publication, *Foot Controls: Riding the Pedal*[8], Barnett writes:

> "…manufacturers have introduced a variety of concepts for minimizing inadvertent activation arising from 'stepping contact.' For example, top barrier guards, side shields, pedal locks, and front gates are used in various combinations. Unfortunately, as the intervention strategies become increasingly successful preventing 'stepping contact,' the foot control becomes more prone to the really insidious problem of 'riding the pedal.'"

In another publication by Barnett and Hamilton, *Philosophical Aspects of Dangerous Safety Systems*[9], December, 1982, the authors use a front-gated foot control as an example of a dangerous safety system. Originally intended to address the hazard of inadvertent foot switch actuation, the front gate resulted in encouraging the practice of riding the pedal due to the added difficulty of inserting one's foot into the pedal. In an effort to compensate for the difficulty associated with inserting one's foot into the pedal housing, the user simply held the front gate open continuously with the foot thereby riding the pedal at those times when the foot should otherwise be removed entirely from the foot control. Barnett and Hamilton wrote[9]:

> "Recently completed research has confirmed what some press manufacturers hypothesized – the mousetrap design is unsafe for most punch press operations since it encourages the practice of 'riding the pedal'"

When a safety system offers an accident hazard potential of its own, there is unequivocal agreement in the safety literature against the use of the safety system. This safety philosophy is highlighted in the December, 1982 publication by Barnett and Hamilton. For example, the National Safety Council wrote in 1975[9]:

> "It is a cardinal rule that safeguarding one hazard should not create an additional hazard."
> [Handbook of Occupational Safety and Health]

Numerous other safety organizations and publication authors have written similar admonitions including:

- Occupational Safety Management and Engineering, Willie Hammer, 1981
- Concepts and Techniques of Machine Guarding, OSHA 3067, 1980
- Motor Operated Appliances, UL 73, Underwriters Laboratories, 1978

- Accident Prevention Manual for Training Programs, American Technical Society, 1975
- Code of Practice: Safeguarding of Machinery, British Standards Institution, 1975
- Machine Guarding, National Safety News, 1971
- General Requirements for All Machines, 29 CFR 1910.212(a)(2), OSHA, 1971
- Supervisors' Safety Manual, National Safety Council, 1970
- Industrial Safety, 3rd ed., Roland P. Blake, 1963
- Guards Illustrated, 1st ed., National Safety Council, 1962
- The Principals and Techniques of Mechanical Guarding, Bureau of Labor Statistics No. 197, U.S. Dept. of Labor, 1959
- Safety Manual for the Graphic Arts Industry, National Safety Council, 1953
- Model Code of Safety Regulations for Industrial Establishments for the Guidance of Governments and Industry, International Labour Office, 1949
- Mechanical Power transmission Apparatus, National Safety Council, 1949
- American Safety Standard Code for Power Presses and Foot and Hand Presses, ANSI B11.1-1948, American National Standards Institute, 1948
- Accident Prevention Manual for Industrial Operations, 1st ed., National Safety Council, 1946
- Occupational Accident Prevention, Judson and Brown, 1944
- Safety Subjects, Bulletin 67 of Division of Labor Standards, U.S. Dept. of Labor, 1944
- Foremanship and Safety, Macmillan, 1943
- Practical Safety Methods and Devices, Cowee, 1916

The undersigned was both a participant and proctor in the foot switch experiments conducted by Barnett in reaching the above-stated conclusion regarding the "riding the pedal" problem.

In February, 1988, Barnett and the undersigned co-authored a publication entitled, *Principles of Human Safety*[10]. The philosophical problem of how to treat safety devices which have a downside is considered. Individual designers and manufacturers should not adopt safety devices that create a new hazard. In those instances when a downside exists with the use of a safety device, a value system (for example, the judicial value system, safety standards committee, etc.) must weigh the upside and downside effect of the particular safeguarding system. If the upside effects are sufficiently compelling, permission is granted to use the safeguard. It is acceptable for an educated consensus group (value system) to make a decision about the use of a safety system that includes a downside, but it is not acceptable for an individual person or individual manufacturer to make a decision of this nature.

The seatbelt is a classic example of a safety device that includes downside effects which has been adopted by a value system and is required on all modern automobiles. The Food and Drug Administration is a classic example of a value system that routinely approves products that involve adverse side effects when the positive effects are judged to sufficiently outweigh the negative side effects.

No value system, i.e. no safety code or standard committee, to date, has made a judgment, recommendation or requirement that foot controls must include a front gate. Clearly, using the method outlined above for evaluating the proposed front gate for foot controls, the safety device must be rejected by an individual designer or product manufacturer due to the new hazard introduced (i.e. riding the pedal and the associated potential for inadvertent control actuation).

Further Evaluation of the Proposed Front Gate

In May, 1995, Barnett and Schmid published a paper entitled, *Safeguard Evaluation Protocol – A decision Tree for Standardizing, Optionalizing, Prohibiting, Ignoring, Enhancing, or Characterizing Safeguards*[11]. The publication describes a protocol developed for assessing whether a candidate safeguard should be prohibited. Barnett and Schmid wrote:

> "This decision making process intellectually disposes of the judicial position that a manufacturer has a nondelegable duty to include safety devices with his machines. It further challenges the advocacy pronouncement that 'safety should not be optional.'"

Utilizing the Machine Supplier Safeguard Decision Tree described in the paper, the proposed safety feature is the front gate for a foot switch control. Next, it is noted that there is no Value System Approval for the proposed safeguard. Next the proposed safeguard must be classified with regard to helping, hurting and/or doing nothing. The foot control gate either helps (reduces the probability of inadvertent pedal actuations) or hurts (increases the potential for riding the pedal thereby increasing the probability of inadvertent actuation).

The decision tree is abundantly clear. The proposed safeguard must not be used.

Conclusions and Opinions

1. The Linemaster Hercules foot control exceeded the safety requirements of the governing safety standard, ANSI B11.3-1973 at the time the accident occurred. In addition to the top guard protecting the pedal from the required hazard of inadvertent actuation from falling objects or stepping onto the pedal, the Linemaster foot control was also equipped with side guards and a toe latch feature. The side guards and toe latch features further decrease the probability of inadvertent pedal actuation.

2. It is not possible to prevent someone from inadvertently stepping into the pedal when the intended use of the pedal involves stepping into it. This holds true for the proposed front gate. Its use is not a guarantee that an inadvertent actuation will not or cannot occur.

3. A top guard alone adequately addresses the ANSI B11.3 requirement of preventing inadvertent actuation due to stepping onto the pedal.

4. A foot control with top and side guard is illustrated in both the 1982 and 2002 revisions of the power press brake safety standard. This style of foot control is acceptable for selection by a reasonable machine tool manufacturer. Heim's choice of foot control, i.e. covered on the top and both sides) exceeded what was considered reasonably safe by the B11.3 safety code committee. The foot control in use at the time of the accident, i.e. with top and side guards and toe latch feature further exceeded the code requirement for protection against inadvertent actuation.

5. The addition of a lift gate onto the front of a foot control does not eliminate the probability of inadvertent actuation of the pedal.

6. The teathered cord feature of the electric foot control allows it to be utilized at a "Safe Distance" from the point of operation. It also allows for its use by a seated operator. The older mechanical foot pedal does not share either of these features. In addition, the electric foot control significantly reduces operator fatigue due to lower actuation forces and reduction of the need to stand balanced on one leg when compared to the older mechanical foot pedal.

7. The work being conducted by Ms. Lindquist at the time of her injury was compatible with either a mechanical foot pedal or an electric foot control. However, neither style of foot actuating means alone was adequate to protect Ms. Lindquist from the point of operation. Corry Manufacturing should have selected a two-hand control device of provided additional barrier guarding to prevent Ms. Lindquist from accessing the point of operation during the press brake operating cycle.

8. The anti-trip Linemaster footswitch product with latch trip lever in use at the time the accident occurred could not have been the foot control product supplied by Heim with the press brake in 1978. Heim did not begin to utilize the foot control with latch trip lever until late in 1982.

9. According to foot control research conducted by Barnett, the addition of a lift gate onto the front of a foot control creates a new hazard by encouraging the user to ride the pedal thereby increasing the potential for inadvertent actuation.

10. An individual manufacturer such as Heim has a responsibility to reject safeguards which create new hazards such as the proposed lift gate on a foot control.

11. There is unequivocal agreement in the safety literature against the use of safeguards that create a new hazard.

12. No value system has weighed the upside and downside effects of the proposed foot control lift gate and found the upside effects to be sufficiently compelling to grant permission to use the safeguard or to make its use mandatory.

13. Utilizing the *Safeguard Evaluation Protocol* published by Barnett and Schmid, the proposed lift gate feature for foot controls must be rejected.

14. The presence of a lift gate on a foot control has no effect on the misuse of riding the pedal since an operator who is committing this unsafe act has already bypassed the lift gate through failing to remove the foot after each pedal actuation. There is no foot control or foot pedal design that prevents the misuse of riding-the-pedal.

15. The foot control in use at the time of Ms. Lindquist's accident was reasonably safe for its intended use on the Heim press brake.

All of my opinions outlined above are stated to within a reasonable degree of engineering and scientific certainty.

Future Consulting Activities

The undersigned reserves the right to amend this report in the event additional information becomes available. For example, it is anticipated that a copy of the videotaped foot control testing by Barnett and Ulmenstine will be supplied. Commentary and opinions regarding this information will be forthcoming after the tests are reviewed.

Very truly yours
Switalski Engineering Inc.

William G. Switalski

William G. Switalski, P.E.
Mechanical Engineering Safety & Design Consultant

1

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America's Foot Switch Leader

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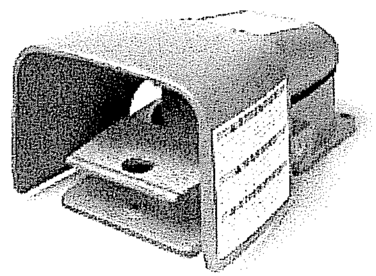
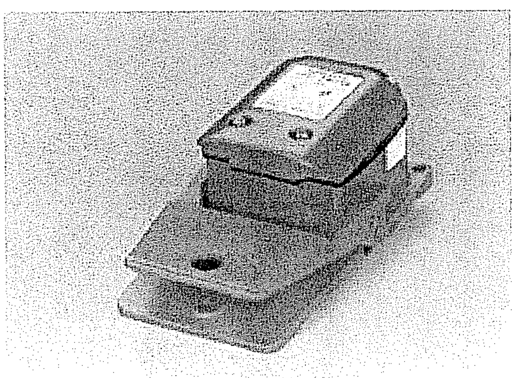
HERCULES
HEAVY DUTY FOOTSWITCH



Hercules Footswitch - Full Shield Model



Hercules Footswitch - No Shield Model

Request A Quote

Environmental Ratings:

NEMA Type 2, 4 & 13
UL ENCLOSURE 2, 4 & 13
CSA ENCLOSURE 2, 4 & 13
EN 60529 Degree of Protection IP56
Driptight - Dusttight - Watertight - Oiltight

Key Benefits

- Rugged cast metal enclosure has sufficient weight to keep the foot switch from sliding when being operated.
- All models have a neoprene cover gasket plus O-rings on the activating shaft and a separate ground screw.
- In all Maintained Contact models the release is accomplished by simply pressing the latch with a light forward movement of the toe. The release is placed under the Full Shield so falling objects cannot easily release it.
- Oversize "O" Shield models accept oversized safety shoes and metatarsal foot guards.
- "OX" Shield also available
- Special Dual 1/2" - 14 N.P.T. threaded conduit entry and metric sizes available to the O.E.M. on special order.
- Special Twin models available to the O.E.M. on special order.
- Painted Alert Orange.
- Single 3/4" - 14 N.P.T. threaded conduit entry is standard.
- 3 holes provided for rigid mounting to the floor or equipment.

Size: 9" x 5-3/4" x 4-3/4"
Weight: Approx. 8 lbs.

SPECIFICATIONS
(Special variations are available to the O.E.M. on special order on the models listed below)

⚠ WARNING

FULL SHIELD	"O" SHIELD	"OX" SHIELD	WITHOUT SHIELD	STAGE	CIRCUIT	FORM	ELECTRICAL RATINGS
531-SWH	531-SWHO	531-SWHOX	531-SWN	Single	SPDT	C	
571-DWH	571-DWHO	571-DWHOX	571-DWN	Single	SPDT	C	
532-SWH	532-SWHO	532-SWHOX	532-SWN	Single	DPDT	C	
572-DWH	572-DWHO	572-DWHOX	572-DWN	Single	DPDT	C	
533-SWH	533-SWHO	533-SWHOX	533-SWN	Single	TPDT	C	
573-DWH	573-DWHO	573-DWHOX	573-DWN	Single	TPDT	C	20 A 125-250 VAC 1 H.P. 125-250 VAC Heavy Pilot Duty 250 VAC Max.
534-SWH	534-SWHO	534-SWHOX	534-SWN	Two	SPDT	C	
574-DWH	574-DWHO	574-DWHOX	574-DWN	Two	SPDT	C	
574-DWHA*	574-DWHOA*	574-DWHOXA*		Two	SPDT	C	
574-DWHD**	574-DWHOD**	574-DWHOXD**		Two	SPDT	C	
535-SWH	535-SWHO	535-SWHOX	535-SWN	Three	SPDT	C	
575-DWH	575-DWHO	575-DWHOX	575-DWN	Three	SPDT	C	
575-DWHA***	575-DWHOA***	575-DWHOXA***		Three	SPDT	C	
536-SWH	536-SWHO	536-SWHOX	536-SWN	Single	SPDT DB±	Z	
576-DWH	576-DWHO	576-DWHOX	576-DWN	Single	SPDT DB±	Z	
537-SWH	537-SWHO	537-SWHOX	537-SWN	Single	DPDT DB±	Z	15 A 125-250 VAC 1/2 H.P. 125 VAC 1 H.P. 250 VAC Heavy Pilot Duty 250 VAC Max.
577-DWH	577-DWHO	577-DWHOX	577-DWN	Single	DPDT DB±	Z	
538-SWH	538-SWHO	538-SWHOX	538-SWN	Two	SPDT DB±	Z	
578-DWH	578-DWHO	578-DWHOX	578-DWN	Two	SPDT DB±	Z	
578-DWHA*	578-DWHOA*	578-DWHOXA*		Two	SPDT DB±	Z	
578-DWHD**	578-DWHOD**	578-DWHOXD**		Two	SPDT DB±	Z	

±DB Double Break models must be wired to equal voltage sources and the same polarity.
The loads should be on the same sides of the line.
S - Denotes MOMENTARY CONTACT - Press to Start - Release to Stop.
D - Denotes MAINTAINED CONTACT - Press to Start - Release Latch to Stop.
O - Denotes oversize O - shield models which accept oversized safety shoes and metatarsal foot guards.

OX - Denotes extra oversize shield models.
***1st stage Maintained 2nd stage Momentary. **1st stage Momentary 2nd stage Maintained. ***1st stage Maintained 2nd & 3rd stage Momentary.**
BOLD COPY INDICATES STOCK ITEM

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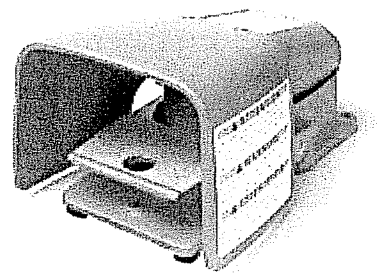
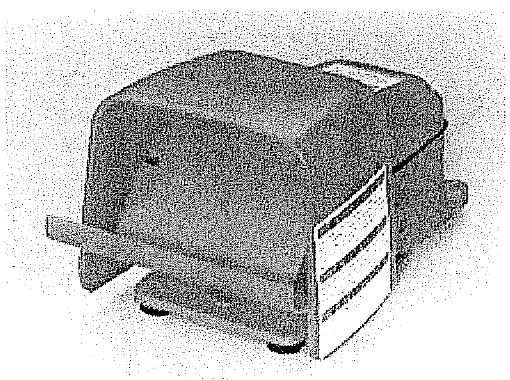
HERCULES ANTI-TRIP
HEAVY DUTY INDUSTRIAL CONTROL



Hercules Anti-Trip Footswitch
Full Shield Model



Hercules Anti-Trip Footswitch
O Gated Shield Model

Environmental Ratings:

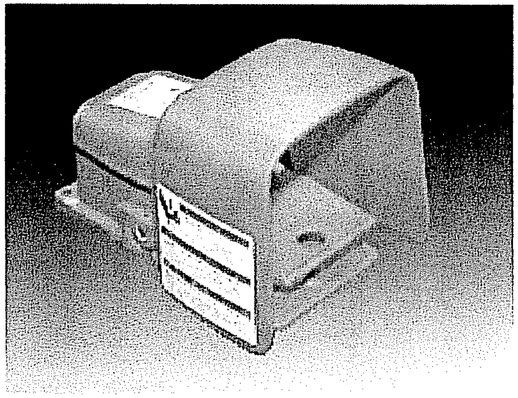
NEMA Type 2, 4 & 13
UL ENCLOSURE 2, 4 & 13
CSA ENCLOSURE 2, 4 & 13
EN 60529 Degree of Protection IP56
Driptight - Dusttight - Watertight - Oiltight

ADVANCED DESIGN HELPS PREVENT ACCIDENTAL ACTUATION

Key Benefits

- Heavy duty foot switch features an anti-trip treadle mechanism that helps prevent accidental actuation through unintentional stepping on foot treadle.
- Switch operation requires that the latch trip lever be released prior to depressing the foot treadle. An in-line foot pressure is applied to the latch trip lever located at the rear of the foot treadle.
- Smooth trip lever release and treadle depression motion results in good rate of operation.
- Oversize "O" Shield models accept oversized safety shoes and metatarsal foot guards.
- Special Dual 1/2"-14 N.P.T. threaded conduit entry and metric sizes available to the O.E.M. on special order.
- Special Twin models available to the O.E.M. on special order.
- Special Airval models available to the O.E.M. on special order.
- Painted Alert Orange.
- Single 3/4"-14 N.P.T. threaded conduit entry is standard.
- Dual treadle return springs and latching mechanism.
- Anti-skid rubber feet and 3 holes for rigid mounting to floor or equipment.
- All LINEMASTER foot switches can be CE marked.

Size: 9" x 5-3/4" x 4-3/4"



Hercules Anti-Trip Footswitch
OX Shield Model

Weight: Approx. 8 lbs

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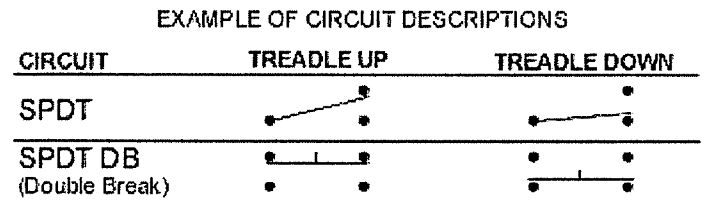
SPECIFICATIONS
(Special variations are available to the O.E.M. on special order on the models listed below)

⚠ WARNING

FULL SHIELD	"O" SHIELD	"OX" SHIELD	WITH GATE	"OX" WITH GATE	STAGE	CIRCUIT	FORM	ELECTRICAL RATINGS
511-B	***511-BO***	***511-BOX***	511-BG	511-BOXG	Single	SPDT	C	20 A 125-250 VAC 1 H.P. 125-250 VAC Heavy Pilot Duty 250 VAC Max.
511-B2*	511-B2O*	511-B2OX*	511-B2G*	511-B2OXG*	Single	DPDT	C	
511-B2A	511-B2OA	511-B2OXA	***511-B2GA***	511-B2OXGA	Two	SPDT	C	
511-B3	511-B3O	511-B3OX	511-B3G	511-B3OXG	Single	SPDT DB±	Z	15 A 125-250 VAC 1/2 H.P. 125 VAC 1 H.P. 250 VAC Heavy Pilot Duty 250 VAC Max.
511-B4*	511-B4O*	511-B4OX*	511-B4G*	511-B4OXG	Single	DPDT DB±	Z	
511-B4A	511-B4OA	511-B4OXA	511-B4GA	511-B4OXGA	Two	SPDT DB±	Z	

BOLD COPY INDICATES STOCK ITEM



***One pole of these models has an adjustable actuating mechanism that enables you to make or break one pole before the other. EXAMPLE: You can break the N.O. Circuit long before you would remake a N.C. Circuit in a 511-B2.**
±DB Double Break models must be wired to equal voltage sources and the same polarity. The loads should be on the same sides of the line.

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LINEMASTER® AMERICA'S FOOT SWITCH LEADER

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WARNING

USE OF FOOT CONTROLS ON MACHINERY LACKING EFFECTIVE POINT OF OPERATION SAFEGUARDS CAN CAUSE SERIOUS INJURY TO THE OPERATOR.

Foot controls should only be used where "Point of Operation" and "Pinch Point" guarding devices have been properly installed and are utilized so that it is IMPOSSIBLE for the operator's hands or fingers to remain within the point of operation during the machine cycle.

POINT OF OPERATION - *The point or area of the machine or equipment where the work piece or material is actually positioned and work is being performed during any process such as cutting, shearing, punching, forming, welding, riveting, assembling, etc.*

PINCH POINT - *Any point at which it is possible for a portion of the body to be caught and injured between moving machine or equipment or work piece parts.*

IT IS THE RESPONSIBILITY OF THE USER to determine the suitability of a foot control for the user's intended use and to determine that the foot control chosen by the user and wiring up and installation of same will comply with all Federal, State and Local safety and health regulations and codes.

Due to the unlimited variety of business equipment, instruments, machines and vehicles on which our foot switches are used, the thousands of standards, and customers' varying interpretations of the standards covering these applications, it is impossible for LINEMASTER personnel to be experts on standards and requirements for all these products. We offer over 150 stock foot switch models and guards plus a large variety of specials which are made to customer specifications. We can advise you what is available in our foot switch line and you can examine models to see what meets your needs. We believe our customers' engineering departments should be the qualified experts in their own product field and know what specifications or details they may require in a foot switch for their equipment. If one of our stock models meets their needs, they can specify it, or possibly ask for a modification of a stock model if that is required.

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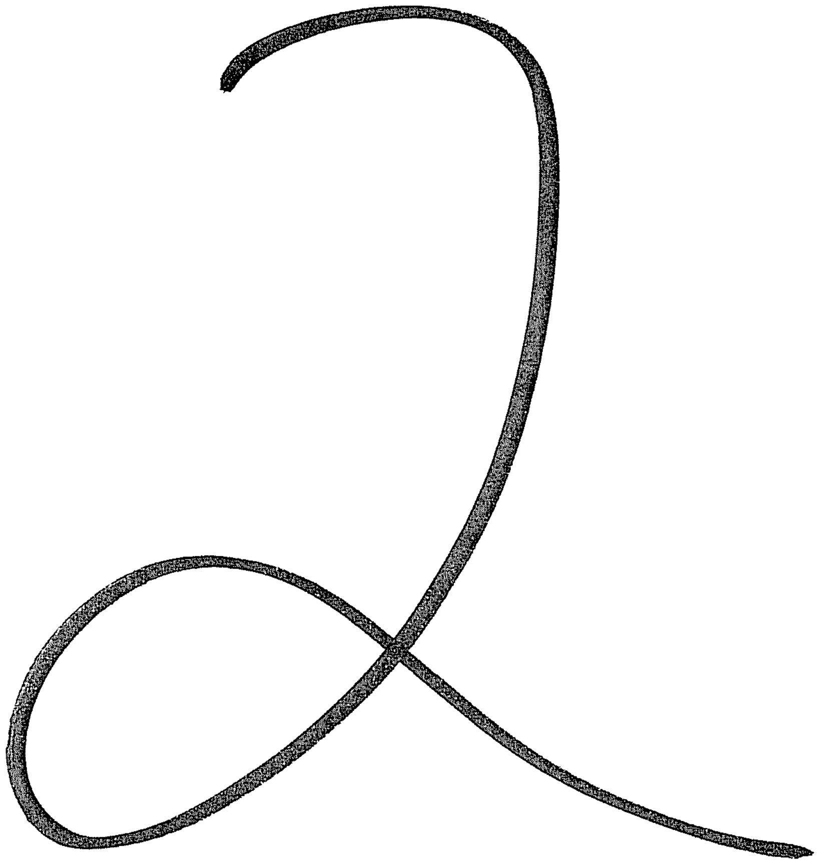

ANSI
B11.3-1973

American National Standard Safety Requirements for the Construction, Care, and Use of Power Press Brakes

Secretariat

National Safety Council
National Machine Tool Builders' Association

Approved February 15, 1973

American National Standards Institute, Inc

3.22.3.2 Push or Slide Feeding (Hand-Operated). A pusher or slide can be used to feed a blank under the punch, and is withdrawn after the operation is performed. The pusher or slide may have a machined nest to fit the shape of the part. If the part does not drop through the die or is not ejected by other means, it can be withdrawn by the pusher or slide.

E 3.22.3.2 Push or Slide Feeding (Hand-Operated)

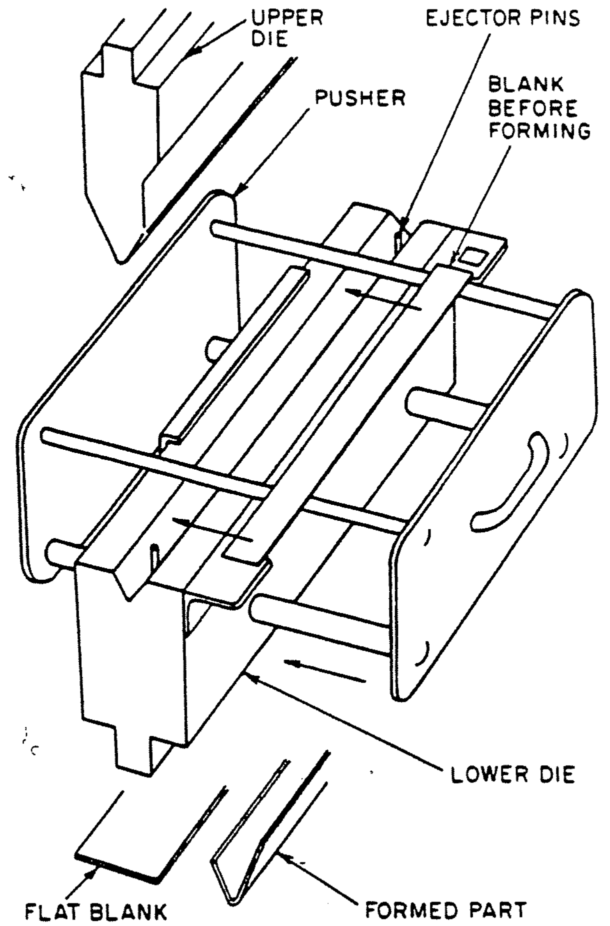

Illustration 9
Example of Push or Slide Feeding

3.23 Foot Control. A foot control is the foot-operated control mechanism (other than foot pedal) designed to control the movement of the ram on mechanical, hydraulic, or special-purpose power press brakes.

3.24 Foot Pedal. A foot pedal is the foot-operated lever designed to operate the mechanical linkage that directly engages the clutch and disengages the brake on a mechanical power press brake while the pedal is held depressed.

3.25 Foot-Treadle Bar. A foot-treadle bar is a bar that is moved in a vertical direction when depressed by the foot of the operator at any point along its length. This bar is attached to two lever arms pivoted from the outside surface of the frame and is connected through linkage to the clutch and brake.

E 3.23 Foot Control. This control usually takes the form of an electrical switch that operates a solenoid or solenoid valve.

3

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automatic machine-initiated and controlled stroking. The selection of manual or automatic return stroking shall be by a means capable of being supervised by the employer. The manual opening-stroke controls shall be designed to override the closing-stroke section regardless of selected mode.

(3) The stroking control shall be designed to incorporate a means for stopping the ram at the top of the stroke even if the operator(s) fails to release the operating means.

4.3.4.2 Stop Control. The stopping of ram movement by actuation of a stop button or by release of the ram-operating control means during the holding distance or automatically at the completion of a ram cycle must be assured by the highest order of reliability. The stop control shall incorporate design features that minimize the possibility of the press-brake ram being unresponsive to a stop signal.

E 4.3.4.2 Stop Control. The system controlling the stopping of the ram extends from the motion pickup on the drive or ram to the cylinder ports of the ram-stroking control valves. Stop signals can come from: 1) emergency stop control, 2) operating means, and 3) top stop control.

4.3.4.2.1 Emergency Stop Control. An emergency stop control(s) identified by a large exposed red button readily available to the operator shall be provided to immediately stop the ram movement by momentary actuation of this control. The emergency stop control shall override every other press-brake control. Reactuation of the ram movement shall require the use of the operating means which has been selected.

E 4.3.4.2.1 Emergency Stop Control. An emergency stop control should be available to the operator. It is recommended that every operator station include one. Its use is most commonly not associated with an emergency situation.

4.3.4.3 Foot Control. A foot control, if used, shall be protected so as to inhibit accidental actuation by falling or moving objects, or by someone stepping on it.

A foot control may include both the up and down functions in one mechanism or may separate them in two mechanisms wherein one controls up and one controls down, and release of either stops the ram motion.

4.3.4.4 Ram-Reversing Control System. The ram-reversing control system shall incorporate a means to interrupt and override the closing movement of the ram. This means shall be incorporated in the operator control stations.

E 4.3.4.4 Ram-Reversing Control System. One example of the ram-reversing control system is the up button incorporated within the operator control station on a hydraulic press brake, along with two-hand operator-control run buttons which are used to control the downward movement of the hydraulic press-brake ram. This up button would interrupt and override the downward operating means in any operator control station.

4.3.5 Electrical

4.3.5.1 Disconnect Switch. A main disconnect switch or power-circuit interrupter capable of isolating the press brake and control system from the main power supply shall be provided with each power press-brake control system. The disconnect switch shall be capable of being locked only in the "off" position.

E 4.3.5.1 Disconnect Switch. It is the owner's responsibility to ensure that a disconnect switch is installed on each power press-brake operation. Locking the disconnect switch means the use of padlocks, seals, or something as effective. A directly controlled linkage system is also considered as a press-brake control system.

4.3.5.2 Main Drive-Motor Start-Button Actuation Prevention. The hydraulic-pump-motor start button shall be protected against accidental actuation.

E 4.3.5.2 Main Drive-Motor Start-Button Actuation Prevention. One means is to install a depressed motor-start button.

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4.2.4.2 Air-Type Clutch/Brake

4.2.4.2.1 Inch. Machines with air-type clutch/brake shall be designed so as to allow the die setter to have complete control over the ram movement for setting dies, through the actuation of a remote foot control.

The remote foot control shall be protected against accidental actuation and so located that the operator cannot reach into the point of operation while actuating the foot control. If the single control is not remote, the requirement given in 4.4.4.1.2 (1) applies.

E 4.2.4.2.1 Inch. Inch is only intended for use in die setting, not as a production mode for use by the operator.

4.2.4.2.2 Stopping Movement. The stopping movement of the ram motion shall be an integral part of the operation of the foot control on machines with air-type clutch/brake.

E 4.2.4.2.2 Stopping Movement. On this type of machine, the brake is normally engaged and the clutch is normally disengaged.

4.2.4.2.3 Foot Control. A foot control shall have a pad of sufficient dimension to allow even distribution of the actuating pressure as applied by the operator's foot. The pad shall have a nonslip contact area and shall be firmly attached to the control.

E 4.2.4.2.3 Foot Control. The use of conventional foot valves or foot switches that are both portable and storable meets the intent of this requirement.

4.2.4.2.4 Foot-Control Actuation Prevention. The foot control shall be protected so as to inhibit accidental actuation by falling or moving objects, or by someone stepping on it. Means shall be provided for manually locking the foot control to inhibit such accidental actuation.

E 4.2.4.2.4 Foot-Control Actuation Prevention. One way of preventing or inhibiting accidental actuation of the foot control would be to provide a key-operated selector switch. Another way of providing against accidental actuation is shown in Illustration 15.

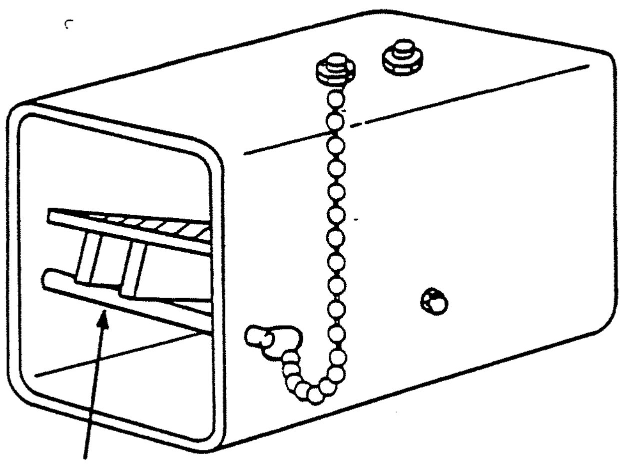

Illustration 15
Mechanical Locking Pin in Place in Foot-Control Stirrup Guard

4.2.4.2.5 Brakes. Friction brakes provided to stop or hold the ram movement shall be set with compression springs. Brake capacity shall be sufficient to stop the motion of the ram quickly, and shall be capable of holding the ram and its attachments at any point in the ram's travel and of being self-engaging when the air engaging force has been exhausted.

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3.24 Foot Control. **The foot-operated control mechanism (other than mechanical foot pedal) designed to control the movement of the ram on mechanical, hydraulic, or special-purpose power press brakes.**

E3.24 Foot Control. This control usually takes the form of a hydraulic valve or an electrical switch that operates a solenoid or a solenoid valve.

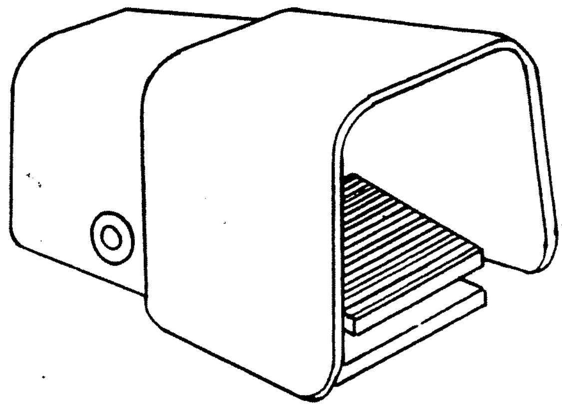

Illustration 15
Example of Foot Control

3.25 Foot Pedal (Mechanical). **The foot-operated lever designed to operate the mechanical linkage. It requires a raising of the foot to place it on the mechanical foot pedal and a significant amount of foot pressure and travel to actuate and engage the clutch and disengage the brake to cause ram motion.**

E3.25 Foot Pedal (Mechanical)

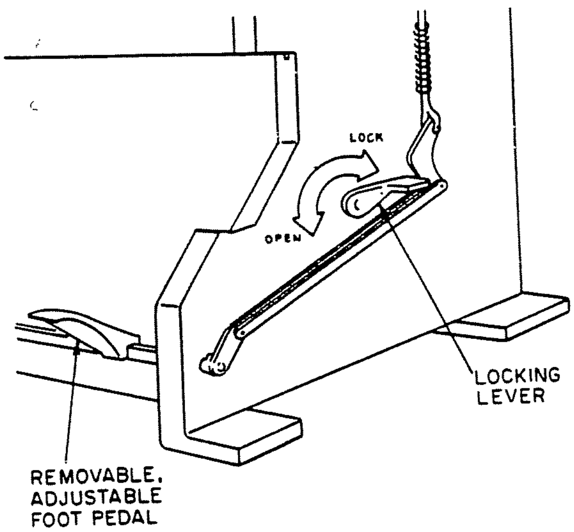

Illustration 16
Example of a Removable and Adjustable Mechanical Foot Pedal

3.26 Foot-Treadle Bar. **A foot-operated bar attached to two lever arms pivoted from the outside surface of the frame and connnected through linkage to the clutch and brake. The bar moves in a vertical direction and requires the raising of the foot and a significant amount of pressure and travel to actuate and engage the clutch and disengage the brake to cause ram motion.**

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ANSI B11.3

American National Standard for Machine Tools –

Safety Requirements for Power Press Brakes

Secretariat and Accredited Standards Developer:

The Association For Manufacturing Technology
Attn.: Safety Department
7901 Westpark Drive
McLean, VA 22102

Approved: FEBRUARY 14, 2002

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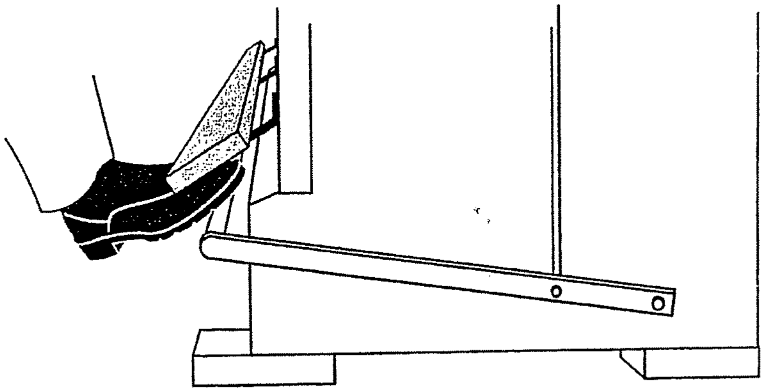

Figure 19
Example of Foot Treadle with Guard

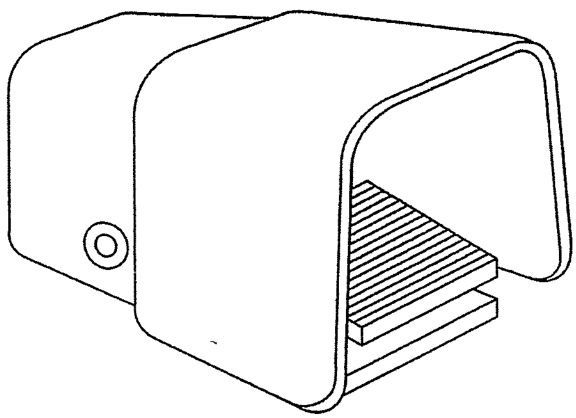

Figure 20
Example of Foot control

7

Safeguarding Equipment and Protecting Workers from Amputations

Small Business Safety and Health Management Series

U.S. Department of Labor Occupational Safety and Health Administration

OSHA 3170
2001

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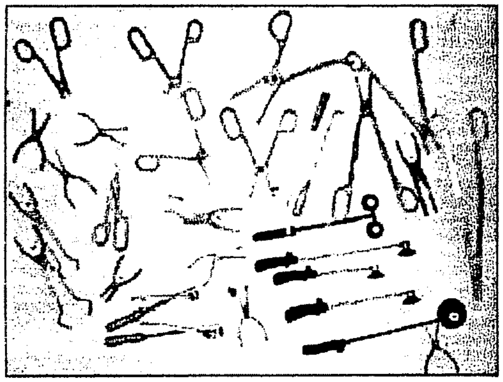
Figure 21. Typical Hand Feeding Tools

Are Foot Controls Another Option?

Foot controls are not safeguards because they do not keep the operator's hands out of the danger area. If you use them, they will need some type of guard or device, such as barriers or pullouts with interlocks capable of controlling the start up of the machine cycle. Using foot controls may increase productivity, but the freedom of hand movement allowed while the machine is operating increases the risk of a point of operation injury. Foot controls must be guarded to prevent accidental activation by another worker or by falling material and not allow continuous cycling. They work best when the operator is in a sitting position. Always avoid the hazard of riding the pedal (keeping the foot on the pedal while not actively depressing it.) (See properly guarded and positioned foot control in Figure 22.)

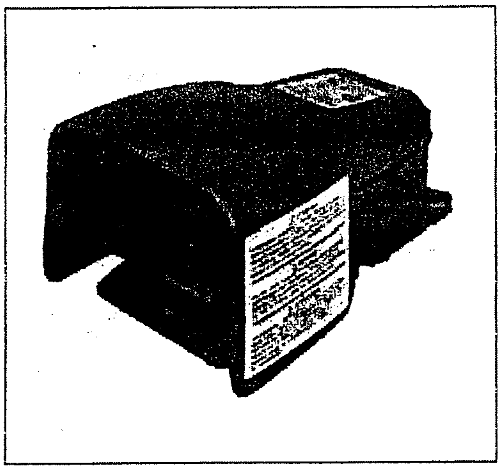
Figure 22. Properly Guarded Foot Control

What About Controls for Machines with Clutches?

Certain machines can be categorized based on the type of clutch they use -- full-revolution or part-revolution. Differing modes of operation for these two clutches determine the type of guarding that can be used.

Once activated, full-revolution clutches complete a full cycle of the slide (lowering and raising of the slide) and cannot be disengaged until the cycle is complete. So, presence-sensing devices may not work and a worker must maintain a safe distance when using two-hand trips. Machines incorporating full-revolution clutches, such as power presses, must also incorporate a single-stroke device and anti-repeat feature.

The part-revolution clutch can be disengaged at any time during the cycle to stop the cycle before it completes the down stroke. For example, part-revolution presses can be equipped with presence-sensing devices, but full-revolution presses cannot. Likewise, hydraulic presses can be

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SAFETY BRIEF

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Foot Controls: Riding the Pedal

by Ralph L. Barnett*

ABSTRACT

The two predominant scenarios for accidentally tripping a foot control are stepping into the foot control and onto the pedal, i.e., "stepping contact" and keeping one foot on or just above the pedal at all times, i.e., "riding the pedal." This study shows that the various designs used to minimize "stepping contact" exacerbate inadvertent activation by "riding the pedal."

I. INTRODUCTION

Foot controls are used to activate machines in a variety of circumstances. A machine's productivity in the manual mode often requires that the operator's hands be utilized during the entire operational profile. A plethora of controls may require all of the operator's appendages. In situations where the hands can become entrapped, prudent safety management may require emergency stop foot switches or foot valves. Intervention systems for carpal tunnel syndrome arising from two hand hostage controls may adopt foot controls. In all such cases there are periods where both hands may be exposed to point of operation hazards.

It is a universal admonition in machine design that controls be fashioned to minimize the probability of accidental activation. *Tripping* is the worry when foot controls are employed because operators seldom scrutinize the floor surface when they're working. This leads to inadvertent activation of the foot controls which produces unexpected start up of the machinery. This, of course, compromises the safety of both personnel and equipment and often destroys the workpiece being processed. Operators who are misusing the machines are usually protected during random cycling by point-of-operation guards or devices; maintenance personnel and bystanders are almost always at risk.

Old fashioned foot controls (circa 1930) would typically consist of a foot pedal located at a fixed station and disposed about six inches above the floor. Activation forces of over sixty five pounds were common and the associated pedal throw was about

* Professor, Mechanical and Aerospace Engineering, Illinois Institute of Technology, Chicago, and Chairman of the Board, Triodyne Inc., Niles, IL.

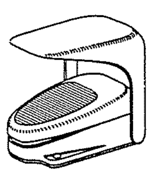
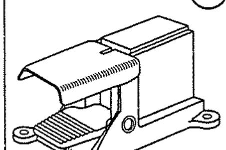
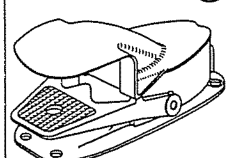
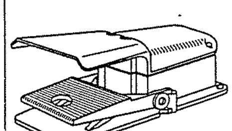
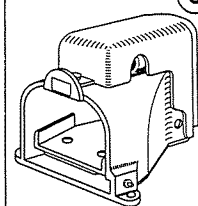
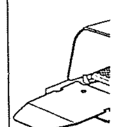
Foot Controls	①  **Linemaster Clipper** No. 632-S	②  **Rees** Style 1814	③  **Square D** Type AW2	④  **Linemaster Hercules** Type AW2	⑤  **Schrader** 1888W	 **Aller** 805- (Front gu
Reciprocating Strokes/30 sec.	*Avg.* 48.72 *St'd Dev.* 8.95	*Avg.* 48.36 *St'd Dev.* 10.40	*Avg.* 47.66 *St'd Dev.* 12.59	*Avg.* 46.69 *St'd Dev.* 7.73	*Avg.* 46.44 *St'd Dev.* 8.41	*Avg.* *St'd De*
Pivoting Strokes/30 sec.	*Avg.* 47.06 *St'd Dev.* 8.90	*Avg.* 44.89 *St'd Dev.* 8.58	*Avg.* 42.03 *St'd Dev.* 11.70	*Avg.* 43.86 *St'd Dev.* 7.91	*Avg.* 45.75 *St'd Dev.* 8.63	
Characteristics Height: Width: Min. Force: Throw:	3.0 in. Open Sides 7.0 lbs. 0.375 in.	3.0 in. Open Sides 12.0 lbs. 0.5 in.	2.625 in. Open Sides 5.0 lbs. 0.5 in.	2.625 in. Open Sides 7.5 lbs. 0.75 in.	3.5 in. 6.0 in. 0.75 lbs. 0.625 in.	2.75 in 5.625 i 8.0 lbs 1.0 in.

Fig. 1 Foot Control: Strok

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three inches. With the advent of ergonomics, operator comfort, performance and convenience were addressed and the modern foot control emerged [Ref. 1-8].

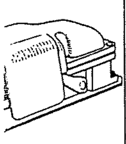
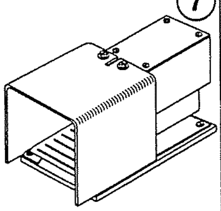
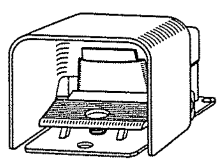
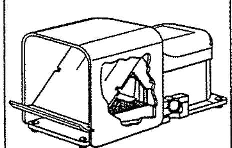
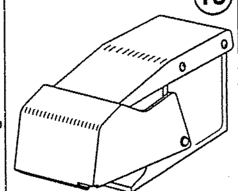
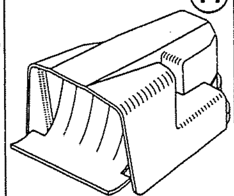
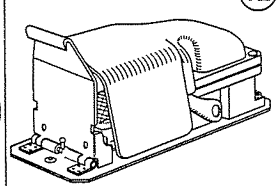
Whereas the old fashioned foot controls were practically immune to "stepping contact," modern foot controls are a safety nightmare. These devices, which are tethered to machines by electric cords or pneumatic hoses, are placed or migrate throughout the operator's work space and constitute serious trip hazards. The pedals are located at an inch and a half above the floor. This distance makes the pedal particularly vulnerable to being stepped on since the normal walking gait brings the toe about two inches above the walking surface. Relatively speaking, the modern pedal is a "hair trigger" with a threshold force of about ten pounds and an associated activation throw in the neighborhood of 3/4 inches.

In response to the safety shortcomings of the modern foot control under misuse conditions (absence of point of operation safeguarding), manufacturers have introduced a variety of concepts for minimizing inadvertent activation arising from "stepping contact." For example, top barrier guards, side shields, pedal locks, and front gates are used in various combinations. Unfortunately, as the intervention strategies become increasingly successful preventing "stepping contact," the foot control becomes more prone to the really insidious problem of "riding the pedal."

II. THE TEST PROGRAM

Three foot control activation scenarios form the basis of our study:

1. *Riding the Pedal*: One foot is continually poised above or just touching the foot pedal until a machine stroke is required. The foot then depresses the foot pedal eventually returning to its position above the pedal. It is never withdrawn from the foot control. "Riding the pedal" is analogous to hunters "keeping their finger on the trigger." Riding the pedal is the most prevalent cause of accidental activation of power presses. When power press

6	7	8	9	10	11	12
						
radley 4316S taped open)	**Rees** 04937-000	**Linemaster Hercules** 511-B2 (Pedal latch)	**Linemaster Hercules** 511-B2G (Pedal Latch and Gate)	**Minster** Type ELL	**Square D** AW-117	**Allen Bradley** 805-A54316S
46.30 9.58	*Avg.* 44.69 *St'd Dev.* 10.29	*Avg.* 36.66 *St'd Dev.* 6.97	*Avg.* 32.82 *St'd Dev.* 6.23	*Avg.* 28.86 *St'd Dev.* 6.02	*Avg.* 25.50 *St'd Dev.* 4.61	Avg. 16.94 St'd Dev. 3.80
	3.5 in. 5.25 in. 9.75 lbs. 0.75 in.	2.75 in. 5.50 in. 13.0 lbs. 0.875 in.	2.75 in. 5.50 in. 13.0 lbs. 0.875 in.	2.75 in. 5.25 in. 9.5 lbs. 0.5 in.	2.875 in. 4.875 in. 10.0 lbs. 0.375 in.	2.75 in. 5.625 in. 8.0 lbs. 1.0 in.

Rates and Characteristics

operators keep their foot deployed over the pedal, accidental activation may occur during sneezing, reaching forward, slipping, and from foot fatigue or being bumped forward.

2. *Pivoting*: Starting with both feet on the floor, one foot is pivoted about the heel and swung into the foot control. It then depresses the foot pedal and swings back into its original position on the floor. "Riding the pedal" does not occur; furthermore, the active foot never lifts or shifts its heel. This strategy is usually available only with open-sided controls. Although side shielded, it was feasible to use the pivot mode with the Schrader foot valve because of its exceptional width (6 inches).

3. *Reciprocation*: Starting with both feet on the floor, one foot is inserted into the foot control by a forward movement followed by a depression onto the pedal. This foot is then moved rearward into its original (starting) position. "Riding the pedal" does not occur. During reciprocation, all of the operator's weight is supported by the non-active foot. This operating mode may be used with either open-sided or side shielded controls.

Our investigation began with the observation that:

The more difficult it is to step into and out of a foot control, the more likely it is that operators will "ride the pedal."

One method of quantifying "activity difficulty" is to measure the maximum stroke rate under speed provoking conditions. Accordingly, a test protocol was formulated for the pivoting mode and the reciprocating mode with the following characteristics:

Participants: Male and female senior engineering students. Only the results of the males are recorded in this study.

Goal: For each foot control candidate the students tried their personal best to maximize the number of activation strokes in a thirty second period. This short time interval was selected to eliminate endurance effects which are not encountered in the workplace.

Position: Each foot control was fixed in location. The students operated the controls from a free standing position.

Practice: One practice run was performed for each foot control candidate.

Fidelity: Strict adherence to the definitions of pivoting and reciprocating was enforced by fellow students.

Incentive: Striving for one's personal best score was influenced by the following factors:

- The students were proctored by the class professor.
- The test program was conducted as a contest with published results.
- Peer pressure
- Machismo

III. TEST RESULTS

Using the test protocol, stroke rates were determined for the twelve foot controls shown in Fig. 1. They are illustrated in descending order of the stroke rate obtained in the reciprocating mode. The first five controls can be activated in the pivoting and reciprocating modes and the associated stroke rates are listed for both. Foot control characteristics illustrated in Fig. 2. are tabulated in Fig. 1. A minimum force is recorded for each candidate that represents the force applied to the lip of the foot pedal which just activates the control. In 1980, the candidate foot controls 1, 2, 3, 4, 5, 7, 8, 10, 11, and 12 were tested one time by each of thirty-six male students. Candidate 6 was tested in 1977; the test was repeated three times by each of sixteen male students. In 1984, candidate 9 was tested by nineteen male students who repeated the trial three times.

Foot controls are grouped below according to the safeguarding systems used to minimize accidental activation from "stepping contact."

1. Top Guard

Top guards preclude foot control activation from the rear and top. Candidates 1, 2, 3, and 4 are top-guarded controls. They may be activated and deactivated from both the front and sides using the reciprocating or pivoting scenarios. Further, they accommodate wide footwear. These utilitarian features also have safety overtones. First, they reduce fatigue by allowing the operator to alternate activation strategies. Second, foot removal is uninhibited leading to very rapid emergency stop commands. Finally, the foot cannot be blocked by a rolling cart, box, or other obstruction to prevent deactivation. Power presses often have a continuous mode that requires constant depression of the foot pedal. The operator intercedes during an emergency by removing his foot from the control.

2. Top Guard and Side Shields

These safeguards are used by candidates 5, 6, and 7. Access to the foot pedal is blocked on the sides which helps reduce "stepping contact." On the other hand, the side shields inhibit somewhat the force movement of the foot during reciprocation. Unlike the open-sided candidates, the pivoting mode is usually not available for relief of fatigue from the reciprocating action. Riding the pedal provides the only feasible respite.

3. Pedal Lock

Candidates 8 and 9 are constructed with a pedal latch that will lock the pedal unless the foot is fully inserted into the foot control and pushed rearward against a vertical plate. After unlatching in this manner, the pedal is depressed to activate the control. Acti-

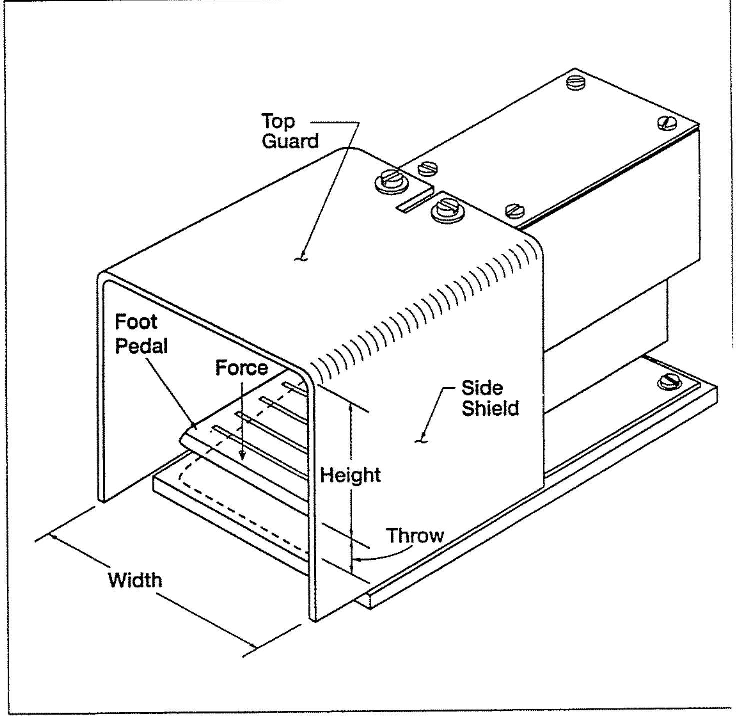


Fig. 2 Foot Control Characteristics

vation of this foot control is generally perceived as a two-step process; unlatch and depress. As it turns out, however, experienced operators hit the latch and pedal in a single motion. Inadvertent partial insertion of the foot will not trip this control.

4. Lift Gate

Candidates 9, 10, and 11 are protected in part by front gates which must first be lifted by the toe to gain access to the foot pedal which in turn must be depressed to activate the foot control. This two-step procedure inhibits both normal and accidental activation by "stepping contact." The gate is effective in minimizing inadvertent intrusion; it does not, however, eliminate the problem. The lower edge of the front flap has a ski nose to help the "camel get his nose under the tent." Striking the ski nose hard with a flat toe shoe will almost always defeat the liftable gate and allow a one motion activation. Candidate 9 combines the liftable gate with a pedal lock. Theoretically, activation is a three step process; lift the gate, unlatch the lock and depress the pedal. As a practical matter, the ski nose enables the process to be accomplished using a single forceful motion.

5. The Drawbridge Flap

Foot control candidate 12 virtually eliminates "stepping contact." Here, a flap is hinged along the bottom and a spring constantly urges the drawbridge type door to its vertical deployed position. Any force applied to the face of the flap closes it tighter. On the other hand, the control is relatively difficult to use. The flap is opened by dragging its upper edge backward with the sole of the shoe. The operator then inserts the foot which is holding the flap open and depresses the pedal to activate the control. The operator's weight is supported on one leg during this process. Proper deactivation of the switch requires the complete removal of the foot which should then be placed on the floor allowing the flap to close. Avoiding continual reopening of the flap requires that the door be continuously held open against its spring closure force. Safety is not promoted by the constant application of a downward force in the neighborhood of the control pedal. Observe that candidate 6 is obtained by taping the flap open on candidate 12. An almost threefold increase in the stroke rates follows.

IV. CONCLUSIONS

1. The reciprocating mode is slightly more efficient than the pivoting mode.

2. There is little difference in efficiency among the first seven candidates which allow for simple reciprocating activation.

3. The efficiency of the open-sided models as a group is slightly greater than the side-shielded candidates represented by models 5, 6, and 7.

4. The open-sided models allow operators to deal with fatigue and discomfort by switching between two almost equally efficient activation strategies; pivoting and reciprocating. The side-shielded candidates offer only "riding the pedal" as an alternate activation method.

5. The motivation to "ride the pedal" increases as one moves from left to right in Fig. 1. Stroke speed decreases by a third. The more difficult it is to step into and out of a foot control, the more likely it is that operators will "ride the pedal."

6. As we move from left to right in Fig. 1, the foot controls pose a decreasing likelihood of an accidental "stepping contact." The easier it is to activate a control advertently, the easier it is to trip it inadvertently. The speed provoked rate is observed to decrease as one progresses from models 1 through 12.

7. Conclusion 6 may be partially corroborated by simple geometric and functional observations. If candidates 10 and 11 are removed from the set, it is clear that increasingly severe foot insertion obstacles are being incorporated into the foot controls as one moves from left to right in Fig. 1. Even the extra wide Schrader shows up as the best of the three side-shielded models (5, 6, and 7). Candidates 10 and 11 cannot be ranked by qualitative observations; the actual detailed gate design plays an important role.

8. The resistance to accidental "stepping contact" is inversely related to the propensity for "riding the pedal."

9. The proper selection of a foot control is not straightforward. It involves many considerations including a knowledge of operator movement in the work space, steadiness requirements for part insertion, the use of point-of-operation safeguarding, technology transfer, maximum or continuous stroke rate of the controlled machine and the various anticipated uses of the foot control on multi-mode machinery.

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Philosophical Aspects of Dangerous Safety Systems

by Ralph L. Barnett[1] and Beth A. Hamilton[2]

Synopsis

One of the unfortunate trends developing in the product liability movement is the promotion of dangerous safeguarding devices. Such devices arise principally from insufficient research, judicial coercion, and liability proofing. The safety literature presents an unequivocal mandate against the use of safeguarding systems that sometimes present hazards themselves.

The Food and Drug Administration investigates new drugs to establish their benefits, shortcomings and side effects. Unfortunately, the safety profession has no equivalent procedure for screening safeguarding devices to determine their suitability. Dangerous safety systems typically emerge in the following categories:

I. Insufficient Research

Sidewalk Ramps

Good intentions, sometimes politically inspired, often lead to the introduction of safety systems whose drawbacks are not understood because no research has been conducted. Sidewalk ramps, adopted for the safety and convenience of wheelchair-bound citizens, illustrate this situation. Shortcomings associated with the ramps are becoming all too well known. For example:

a) Children on bicycles, skates, and skateboards are shooting down the ramps into traffic;

b) The sightless are complaining that they cannot locate the curbs with their canes; and

c) A serious trip hazard is created by the sharp differences in curb elevation at corners. Almost everyone who frequents downtown Chicago has tripped or experienced a close call. The authors are currently investigating a quadraplegic case attributable to the ramp/trip hazard.

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This article presented at the *American Society of Agricultural Engineers' Seminar on Product Liability Considerations in Design*, Palmer House, Chicago, Illinois 1982.

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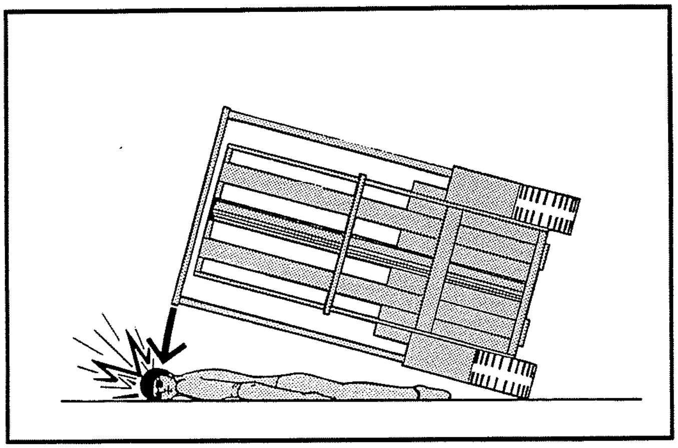
Many communities have tried to minimize the ramp drawbacks by using yellow safety markings to outline the ramp. Snow, of course, covers such markings.

d) When ice reduces the coefficient of ramp friction below the tangent of the ramp angle, one cannot stand on the ramp. On the other hand, steps or curbs can always be negotiated regardless of their slipperiness.

e) Without the curbs, vehicles can more easily invade the sidewalks.

Overhead Guards

To provide protection from falling objects, forklift trucks are required to have overhead guards. When a forklift rolls over, its operator is often thrown several inches up out of his seat, as well as sideways with the vehicle. This puts his head directly in the path of the overhead guard as the vehicle falls. The edge of the top portion of the guard strikes the operator, crushing his skull. (See Figure Below)



Alternate Designs

In many states, a successful plaintiff's position in a product liability lawsuit requires the demonstration of an alternate design which, among other things, would have prevented the plaintiff's injury.[3] Unfortunately, safety devices that ameliorate specific accident scenarios may compromise the overall system safety.

This may be illustrated by an accident involving the explosion of a low pressure gauge with an improper high pressure dial face. The unit was traded in and subsequently tested using a high pressure oxygen bottle. The traded gauge had been assembled by cannibalizing other units. The plaintiff claimed the design was unreasonably dangerous, positing that every pressure range should have unique threads. This would indeed have prevented the coupling of the subject gauge to the high pressure system; however, this solution creates a nightmare for repair departments which must consequently stock a hundred times the number of gauges and fittings to maintain their current maintenance flexibility. Very few maintenance departments could function without the present standardization and the result would be unrepaired gauges and, hence, unsafe hydraulic and pneumatic systems.

Alternate designs inspired by product liability lawsuits are typically under-researched and exert a disproportionate influence on technology.

II. Judicial Coercion

Precedent-setting judicial decisions often compel manufacturers to adopt safety systems which compromise the safety of machinery. As an example, the *Bexiga v Havir* decision from New Jersey places a non-delegable duty on manufacturers to provide safety devices. The decision arose in a trial involving a punch press. It was alleged that the manufacturer should have provided point-of-operation guarding. Unfortunately, every classical safety device for a punch press is a Type IV device,[4] that is, a device that sometimes improves, and other times compromises, the safety of the punch press. Under these circumstances, the safety of these systems can be maximized only by the user who has the input information to select the proper device, from among the many available candidates, to enhance the safety for a particular punch press operation. The required input information involves a knowledge of the in-feed system, the out-feed system, the appliance or die and the nature of the press component itself. Until these items are known, a safe safeguarding system cannot be rationally selected.

III. Liability-Proof Designs

There are massive economic pressures on manufacturers to improve their courtroom and negotiating positions in product liability situations. Significant relief is available to them if they embrace postures consistently adopted by the plaintiff's bar and reflect these positions in their product design and warnings. This is called liability proofing and to the extent that the product liability system is rational, liability proofing will improve safety. Counterexamples, however, are growing in number.

Warning Signs

It is rare that a modern machine does not contain a plethora of warning and caution signs. These rarely deal with hidden dangers; mostly they warn against hazards that are open and obvious and serve only to liability proof the machine. On the other hand, from a safety point of view, they frequently compromise the

(3) *McClellan and Orr v. CTA, 34 111. App. 3d 151.*

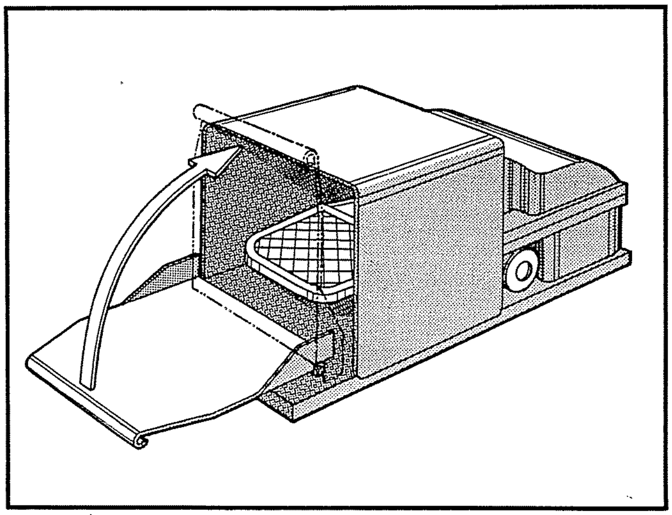
(4) Ralph L. Barnett and Peter Barroso, Jr., "On Classification of Safeguard Devices (Part 1)," *Triodyne Safety Brief* v. 1, #1 *(April 1981).*

machine. For example, too many warning signs produce clutter and increase the probability that none of the signs will be read, including the really important ones. Furthermore, it is difficult to encourage people to take safety signs seriously when most of them are silly — *Expect the Unexpected, A Clean Machine is a Safe Machine, Obey all Signs* and *Don't Place Hands Under Blade.*

These may be contrasted with warnings dealing with hidden dangers - *Danger-20,000 Volts, Machine May Start Unexpectedly in Automatic Mode, Press May Stroke After Motor is Shut Off, Wait Until Flywheel Has Stopped Before Servicing* and *Beware of Guard Dog.*

Foot Switches

Many punch press manufacturers have completely blunted the attack of the plaintiff's bar on foot switches by adopting the "mousetrap" design, i.e., foot switches guarded on all sides with a hinged door at the foot port. Recently completed research has confirmed what some press manufacturers hypothesized — the mousetrap design is unsafe for most punch press operations since it encourages the practice of "riding the pedal." (See Figure Below)



IV. Safety Philosophy

Perhaps the most unequivocal position taken in the safety literature is the admonition against the use of guards which offer accident hazards of their own. We have sampled and excerpted this literature:

1981: Willie Hammer, *Occupational Safety Management and Engineering,* Englewood Cliffs, NJ, Prentice-Hall, 1981.

> "A guard or safety device must have certain characteristics . . . 9. It should not itself constitute a hazard." pp. 220-21.

1980: *Concepts and Techniques of Machine Guarding (OSHA 3067).* Washington, DC, OSHA, 1980.

> "What must a safeguard do to protect workers against mechanical hazards? Safeguards must meet these minimum general requirements: . . . Create no new hazards. A safeguard defeats its own purpose if it creates a hazard of its own, such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration." pp. 7-8

1978: "Motor-Operated Appliances," *UL 73.* Chicago, IL, Underwriters' Laboratories, Aug. 18, 1978.

> "25.4 Some guards are required to be of the self-restoring type. Other features of guards that are to be considered include: . . . E. Creation of additional risk of injury to persons such as pinch points, and the necessity of additional handling because of increased need for servicing, such as cleaning, unjamming, etc. . . ." p. 23.

1975: Merle E. Strong, ed., *Accident Prevention Manual for Training Programs.* Chicago, IL, American Technical Society, 1975.

> "Construction of guards . . . The following points have been compiled to enable the reader to construct an adequate guard or to select one that will meet accepted standards: . . . 5. They should not create additional hazards, such as tripping or obstructing." p. 199.

1975: *Code of Practice: Safeguarding of Machinery. BS 5304: 1975.* London, British Standards Institution, 1975.

> "5.1.2. Construction of safeguards . . . (c) Whatever safeguard is selected it should not itself present a hazard such as trapping or shear points, splinters, rough or sharp edges, or other sources likely to cause injury. In the case of food processing machinery the safeguard should not constitute a source of contamination of the product." p. 4

1975: *Handbook of Occupational Safety and Health.* Chicago, IL, National Safety Council, 1975.

> "It is a cardinal rule that safeguarding one hazard should not create an additional hazard." p. 138

1971: "Machine Guarding," *National Safety News,* v. 103, #5 (May 1971): 48-55.

> "In addition, a proper guard should: . . . Present no hazard itself." p. 48.

1971: "General Requirements for All Machines," *19 CFR 1910.212* (a) (2). Washington, DC, OSHA, effective August 27, 1971.

"General requirements for machine guards: Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazard in itself."

1970: *Supervisors' Safety Manual.* Chicago, IL, National Safety Council, 1970.

"To be generally acceptable, a guard should: . . . 10. Not be a source of additional hazards, such as splinters, pinch points, sharp corners, rough edges or other injury sources." p. 251.

1963: Roland P. Blake, ed. *Industrial Safety,* 3rd ed. Englewood Cliffs, NJ, Prentice-Hall, 1963.

"State codes give the broad, overall requirements for performance or construction, but the effectiveness of the guard is still dependent upon the skill of the designer and the builder to design and construct a guard that is adequate for the purpose, is sturdy enough to withstand hard service, and does not in itself create a hazard." pp. 181-82.

1962: *Guards Illustrated,* 1st ed. Chicago, IL, National Safety Council, 1962.

"To be effective and acceptable, a point-of-operation guard should have among its characteristics those listed here. It should . . . present no hazard itself, such as splinters, pinch points, shear points, sharp corners, rough edges and other sources of injury." p. xi.

1959: *The Principles and Techniques of Mechanical Guarding. Bureau of Labor Statistics Bulletin No. 197,* U.S. Dept. of Labor, 1959.

"Machine guards to be effective must be built in accordance with recognized standards of construction and of performance. They must be designed so as to eliminate the hazard, they must create no hazard of their own, they must be sturdy enough to withstand normal wear, and they should not interfere with production." p. 54.

1953: Lillian Stemp, *Safety Manual for the Graphic Arts Industry.* Chicago, IL, National Safety Council with the Education Council of the Graphic Arts Industry, Pittsburgh, 1953.

"When it is found necessary to build the guards, or have them built, these guards should have these qualifications: . . . 5. Avoidance of being a hazard in themselves (sharp edges, abrasives or splintered surfaces)." p. 7

1949: *Model Code of Safety Regulations for Industrial Establishments for the Guidance of Governments and Industry.* Geneva, International Labour Office, 1949.

"Regulation 82. Guards. General Provisions. 1. Guards should be so designed, constructed and used that they will:(1) not constitute a hazard by themselves (without splinters, sharp corners, rough edges or other sources of accidents) . . ." p. 50

1949: "Mechanical Power Transmission Apparatus," *NSC Safe Practices Pamphlet No. 110.* Chicago, IL, National Safety Council, 1949.

"A good transmission parts guard should be considered a permanent part of the equipment on which it is installed and should . . . (a) not itself present hazards (splinters, sharp corners, rough edges or other sources of injury)." p. 2.

1948: "American Standard Safety Code for Power Presses and Foot and Hand Presses," *ANSI B11.1 -1948.* New York, American National Standards Institute, 1948.

"5.2 General Requirements for Point of Operation Guarding. 5.2.1. Every such device shall be simple and reliable in construction, application, and adjustment. It shall be permanently attached to the press or the die. It shall not offer any accident hazard of itself." pp. 9-10.

1946: *Accident Prevention Manual for Industrial Operations,* 1st ed. Chicago, IL, National Safety Council, 1946.

"Safe guard construction, design and use depend to a great extent on many of the following summarized characteristics. Generally speaking, a guard should: . . . 12. Not constitute a hazard itself (without splinters, sharp corners, rough edges, or other sources of injury)." p.117.

1944: Harry H. Judson and James M. Brown, *Occupational Accident Prevention,* New York, John Wiley, 1944.

"General Requirements for Good Guarding. The general requirements for good guarding of machines are as follows: . . . 3. The guard must not introduce any new hazards of its own: thus it must not offer any sharp corners to cause injury to the employee in passing. It must not introduce tripping hazards or unnecessary striking hazards." p. 102

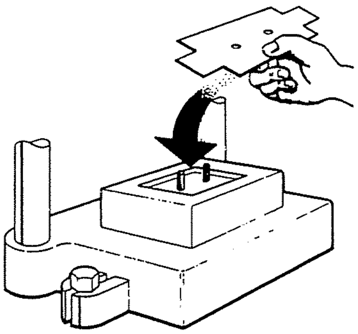
1944: *Safety Subjects. Bulletin 67 of Division of Labor Standards,* U.S. Dept. of Labor, 1944.

"Not only must a machine guard give maximum protection, but it must not interfere with operation or create or contribute to a different hazard." p. 89.

1943: C.M. Macmillan, *Foremanship and Safety.* New York, John Wiley, 1943.

POWER PRESS FEED METHODS is one of a series of safety posters available from our graphics division. The posters depict the areas where each of the classical safety devices is inapplicable and the circumstances where it is unsafe.

HAND FEED



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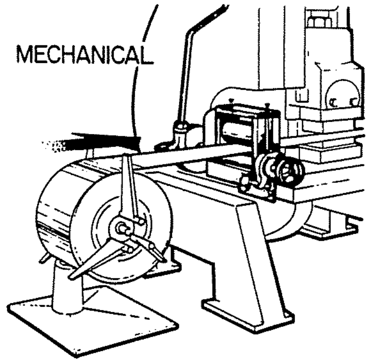

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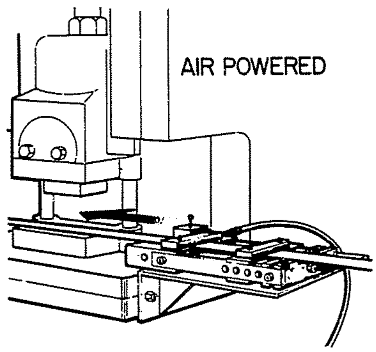

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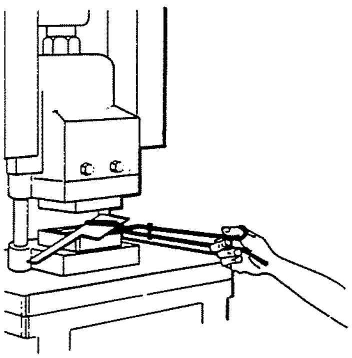

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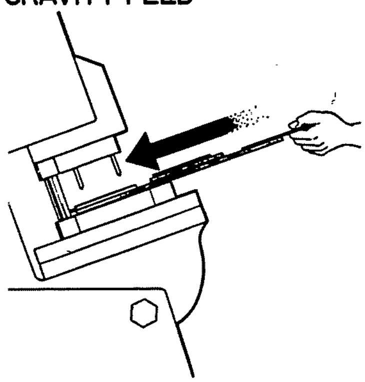

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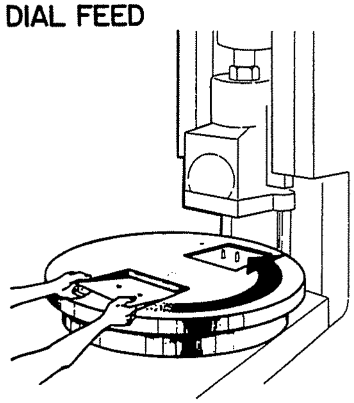
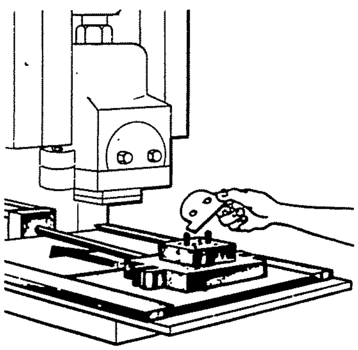
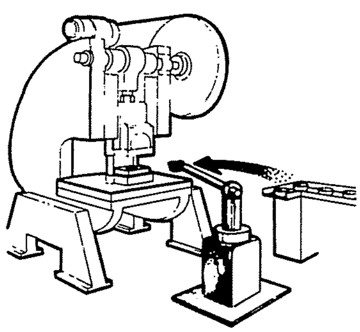


SLIDING BOLSTER PLATE



ROBOT



NOTE: CONTROLS AND GUARDS REMOVED FOR CLARITY.

Graphics by Mary A. Misiewicz

> "In considering a machine guard we must realize that it has to give "tops" in protection and it must not interfere with operation. Also, care must be taken that in guarding against one hazard we do not create another." p. 46.

1916: George Alvin Cowee, *Practical Safety Methods and Devices.* New York, Van Nostrand, 1916.

> "Guards should be designed to meet the requirements at hand. They should be substantially built, effectively protecting the workmen from injury. Poorly constructed, impractical, unsafe guards are far worse than none at all." p. 23.

Editor: Paula Barnett **Produced by Triodyne Graphic Communications Group**

SAFETY BRIEF

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